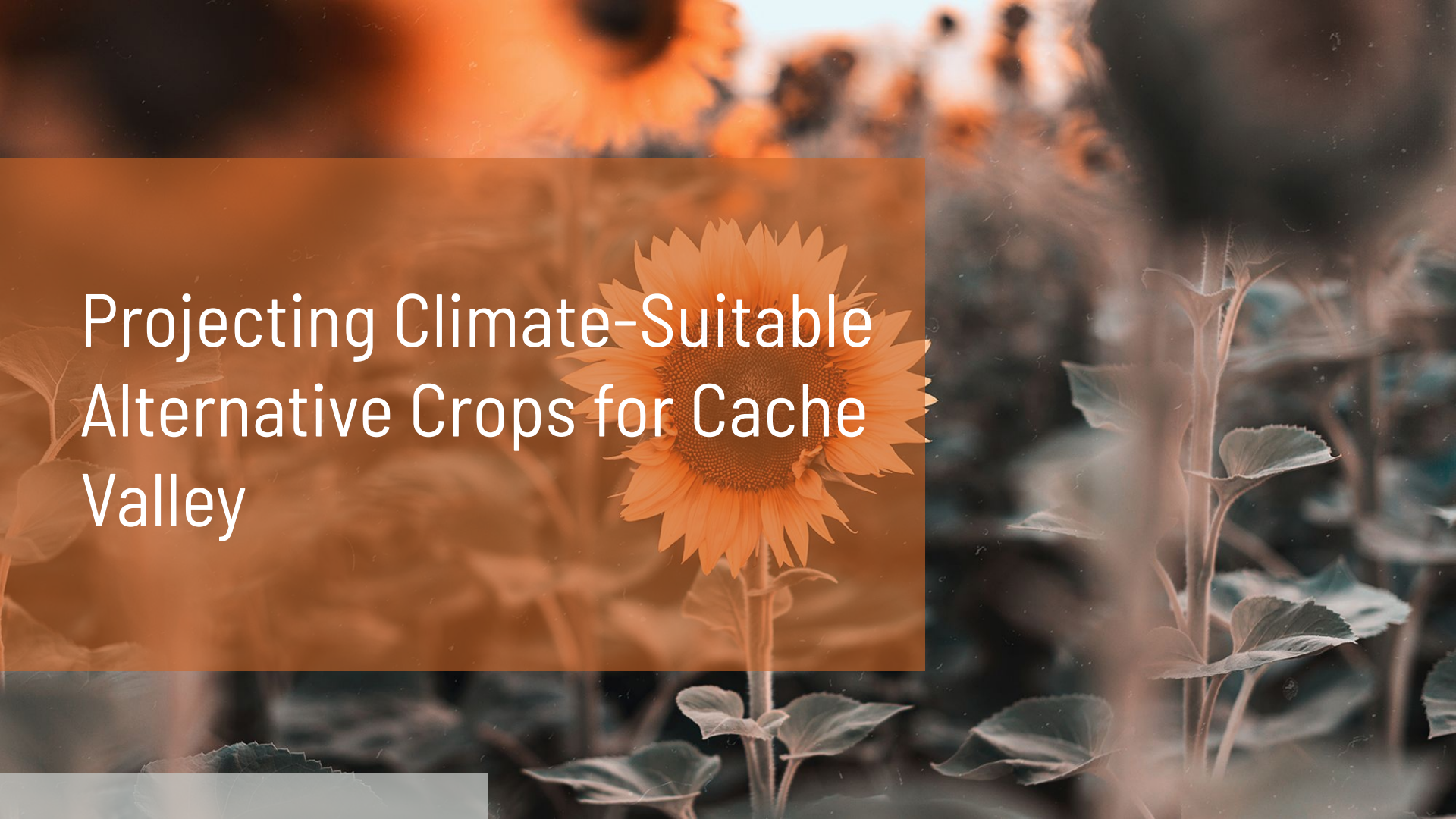


Projecting Climate-Suitable Alternative Crops for Cache Valley

Emily Burgess
PhD
Biology

Jace Colby
MS
Geography

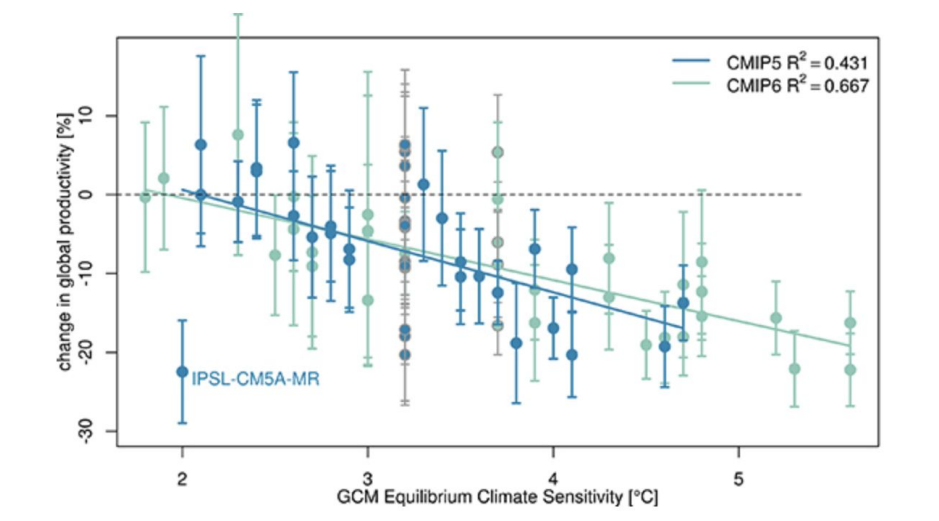
Patrick Kelly
PhD
Environment and Society

Mitchell Parsons
PhD
Wildland Resources

Ren Weinstock
MS
Biology

Background

Global



Climate change is impacting agricultural production currently, and will more so in the future

← Projected changes in global crop productivity under RCP8.5 using CMIP5 and CMIP6 climate models
at the end of the 21st century (2069–2099)

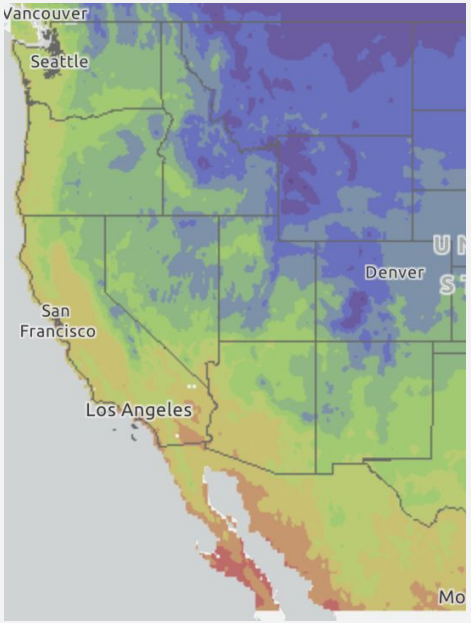
(Mueller et al. 2021, *Environmental Research Letters)*

Background

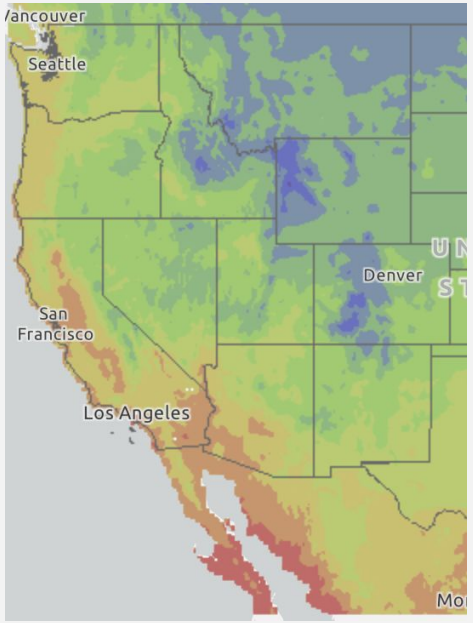
Cache Valley

Shift in USDA Hardiness Zones

1980-2009



2070-2099

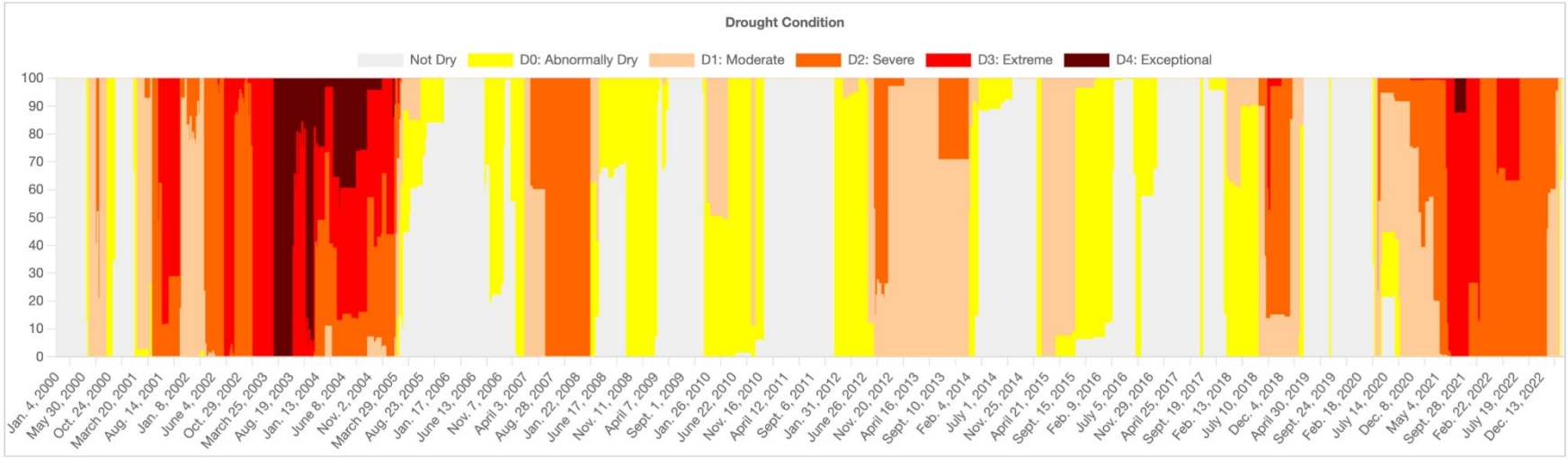


Background

Cache Valley

Drought History

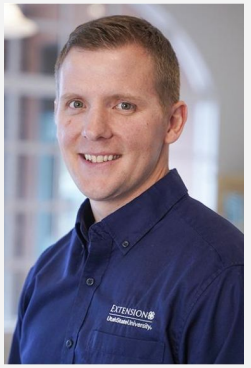
Cache County, UT Drought History



Background

Project formation

	Crop	Uses	Average	Irrigation	Suitability	Suitable	Growing	Frost Free days required	Average yield	Planting costs	N
			inches/day	Months	1-5 rating	ft	F-days	Days	# / acre	$/ac	lb / ac
Current major field crops in Utah	Alfalfa	Feed	0.25	M J J A S O	3	<8500		42-56		$60	
	Silage corn	Feed	0.04 - 0.4	M J J A S O		<7000		110-120		$115	
	Grain corn	Feed, Food, Fuel, Fiber	0.04 - 0.4	M J J A S O		<6000		110-120		$115	
	Winter wheat	Feed, Food	0.04	O N A M J	3	7000		90-100		44	
	Spring wheat	Feed, Food	0.05	A M J J	3	6500		90-100		44	
	Barley	Feed, Food	0.18	A M J J		7500		60-90		23.21(Seed)	
	Oat	Feed, Food	0.19	A M J J		7000+		85-88		19.56(seed)	
	Pasture	Feed	0.04	M J J A S O		<9000		42-56			
Alternative forage crops	Forage small grains	Feed		A M J J		7300+		60-80			
	Sorghum-sudangrass	Feed		M J J A S O	4	6500		60-90		$70	
	Teff	Feed	0.4-0.6	JJAS	3	5900-6900		>50		$30(seed)	
	Forage soybeans	Feed		A M J J A		6500		30-50			
	Forage sugarbeets	Feed	0.28	M A M J J A		7000		120-140?			
Alternative oilseed crops	Flax	Feed, Food, Fiber	0.095	MJJA		6000		85-100		22.80(S/T)	
	Safflower	Feed, Food, Fiber	0.12	MJJA	5	<3500		120		14.78(seed)	
	Sunflower	Food	0.24	A M J J A		<5000		120-130		$48.31	
	Canola	Food	0.2	AMJJA	5	<5000		73-83		$60(S/T)	
	Sesame	Food	0.22	JJA	5	<4000		120		$21(seed)	
Alternative grain crops	Dry edible beans	Food	0.12	JJAS	3	<4500		95-105			
	Grain sorghum	Food, Fuel	0.17	A M J J A		10000		90-120		14.76(seed)	
	Lentils	Food	0.09	MJJ	4	12000		85-100			
	Pearl Millet	Feed, Food	0.15	MJJAS	5	>4000		70-90			
	Quinoa	Food	0.085	MJJAS	4	<13000		120		$32	
	Spelt	Food		AMJJA	3			100			
	Triticale	Feed, Food	0.13	AMJJA	4			100			
Alternative industry crops	Cannibas	Medicinal	0.14	MJJAS				120-180			
	Lavendar	Medicinal	0.17	AMJJA	4			>60			
	Cannibas	Fiber, Oil	0.14	MJJAS	2			60-90 (fibre); 90-120 (grain)			



Matt Yost

Plants, Soils, & Climate (PSC)

Associate Department Head | Associate Professor | Agroclimate Extension Specialist

Objectives

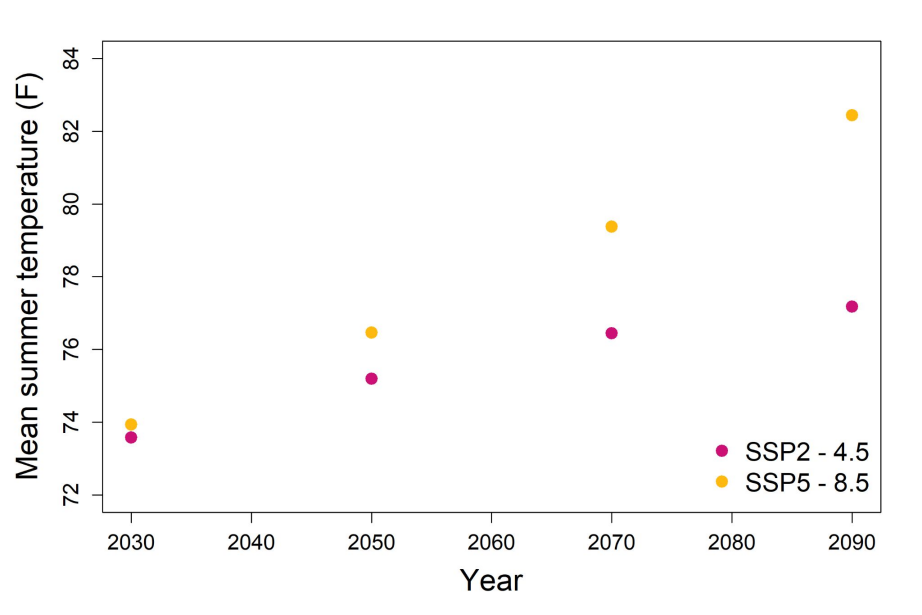
1. Assess suitability of commonly grown crops to future climate projections in Cache valley.
2. Identify alternative crops suitable to future climate scenarios
3. Create comparative tool and fact sheets for growers

Outline

1. Climate modeling
2. Economic data
3. Stakeholder input & final products

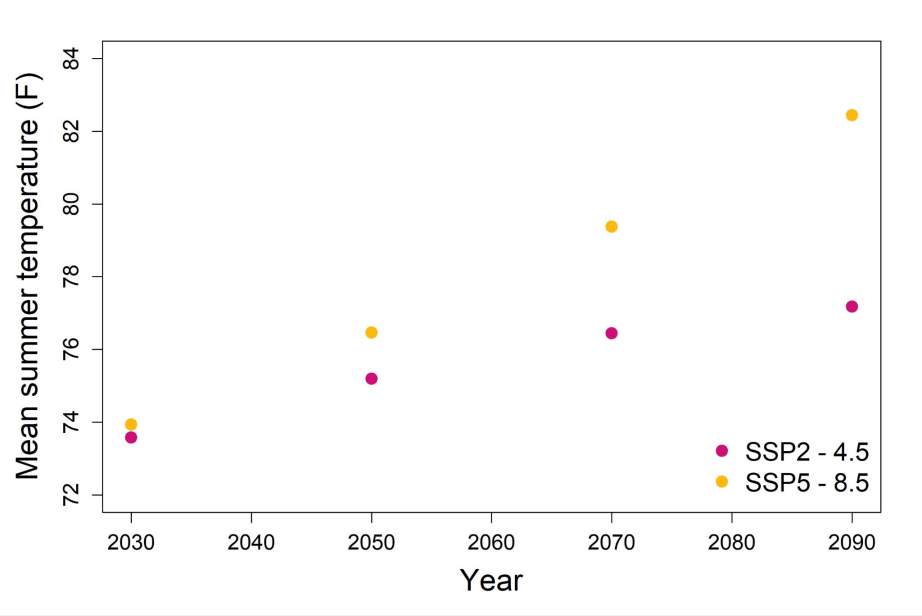
Climate Projections

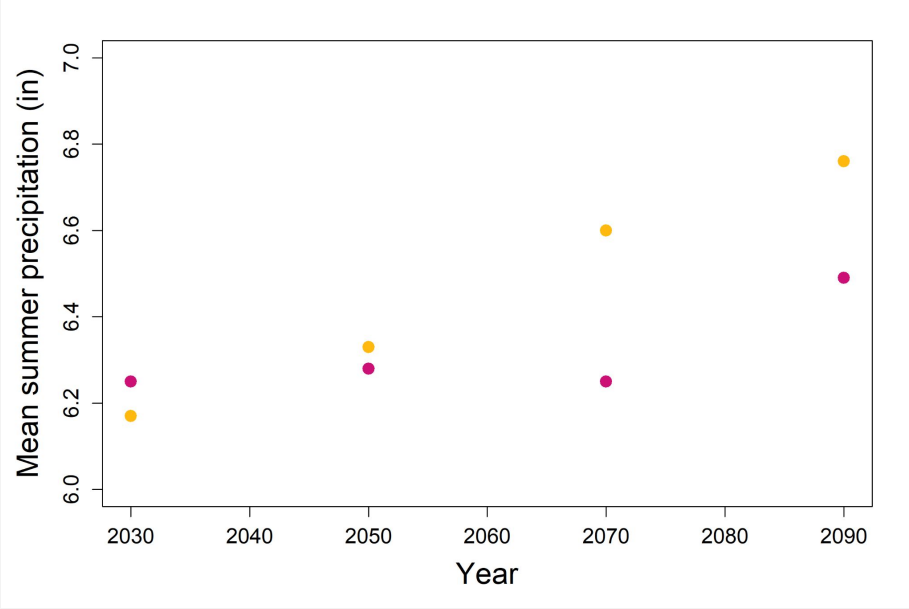
Change in Summer (May-Sept) Temperature



Climate Projections

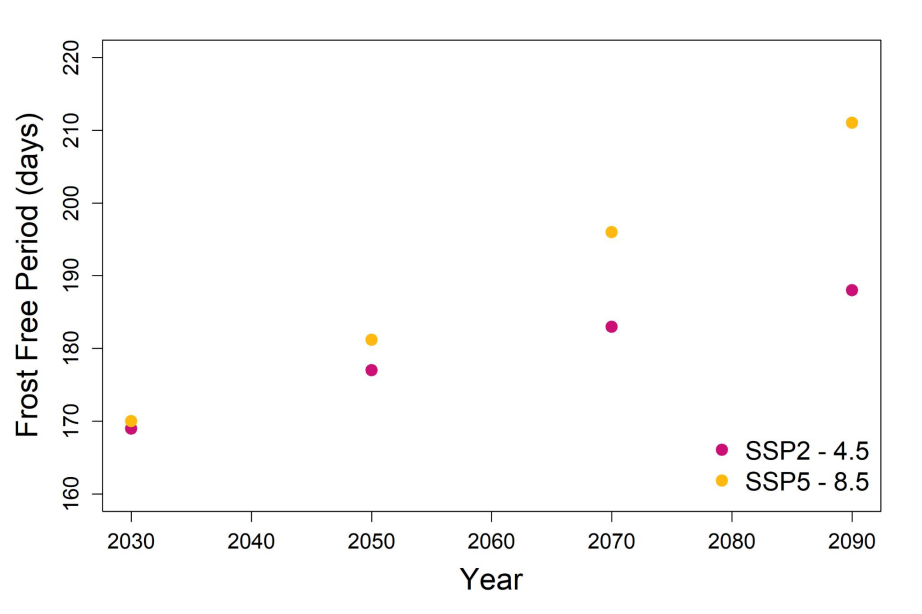
Change in Summer (May-Sept) Temperature and Precipitation





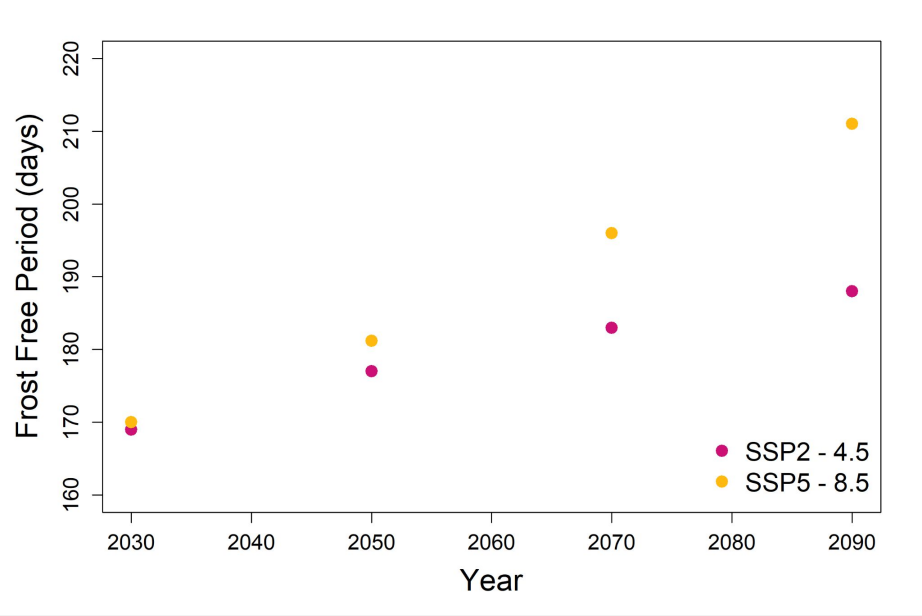
Climate Projections

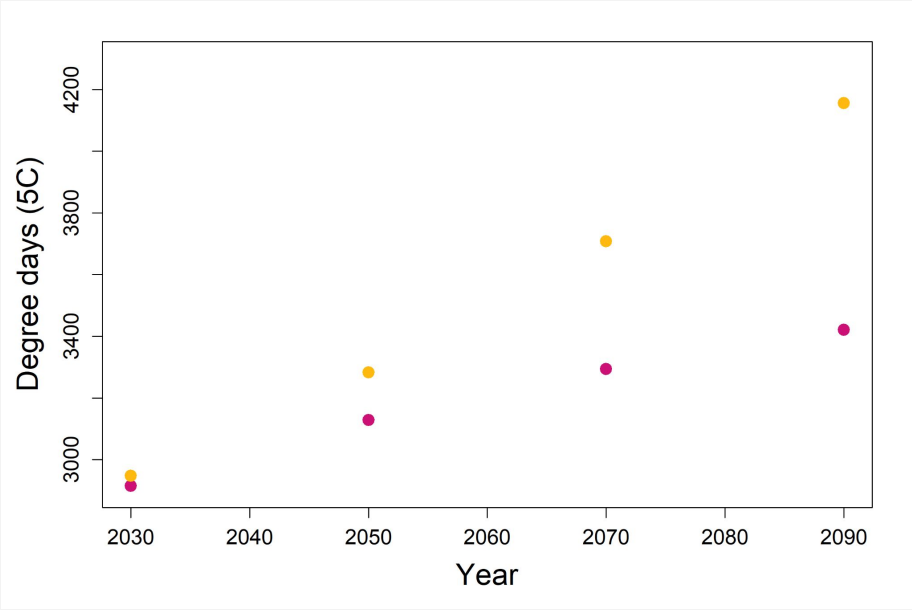
Change in Frost Free Days



Climate Projections

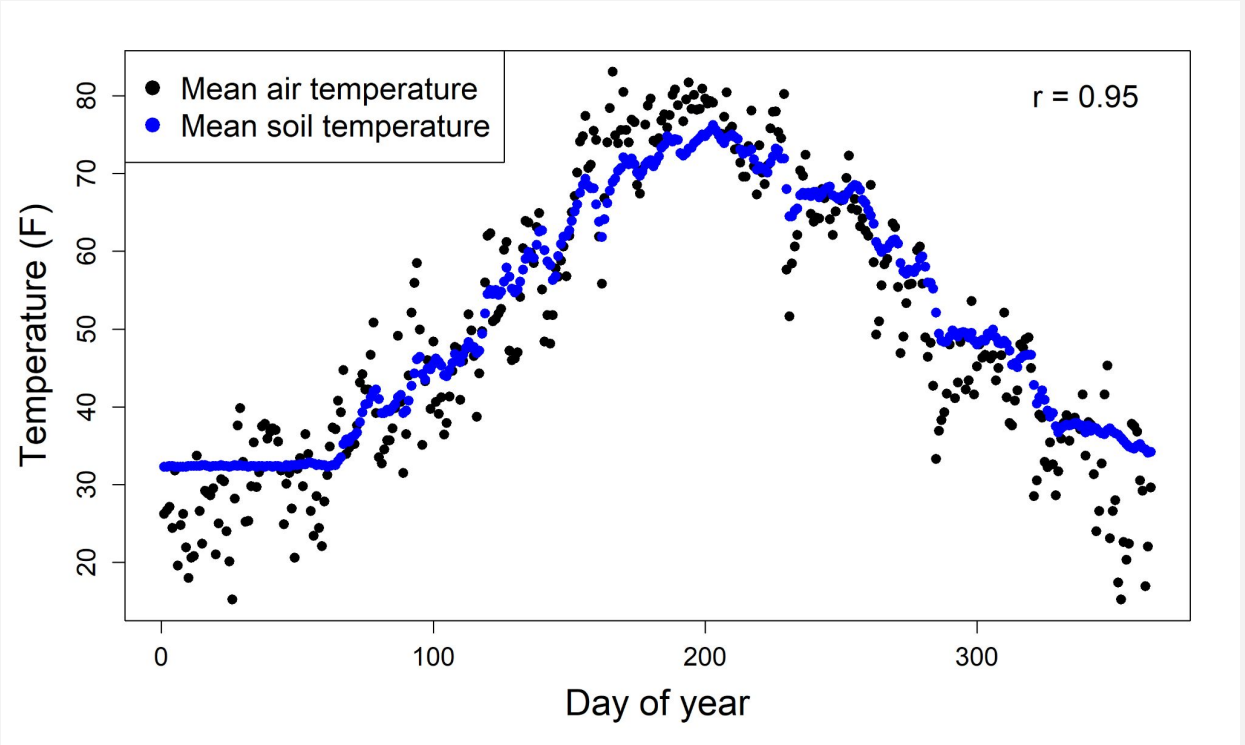
Change in Frost Free Days and Degree Days





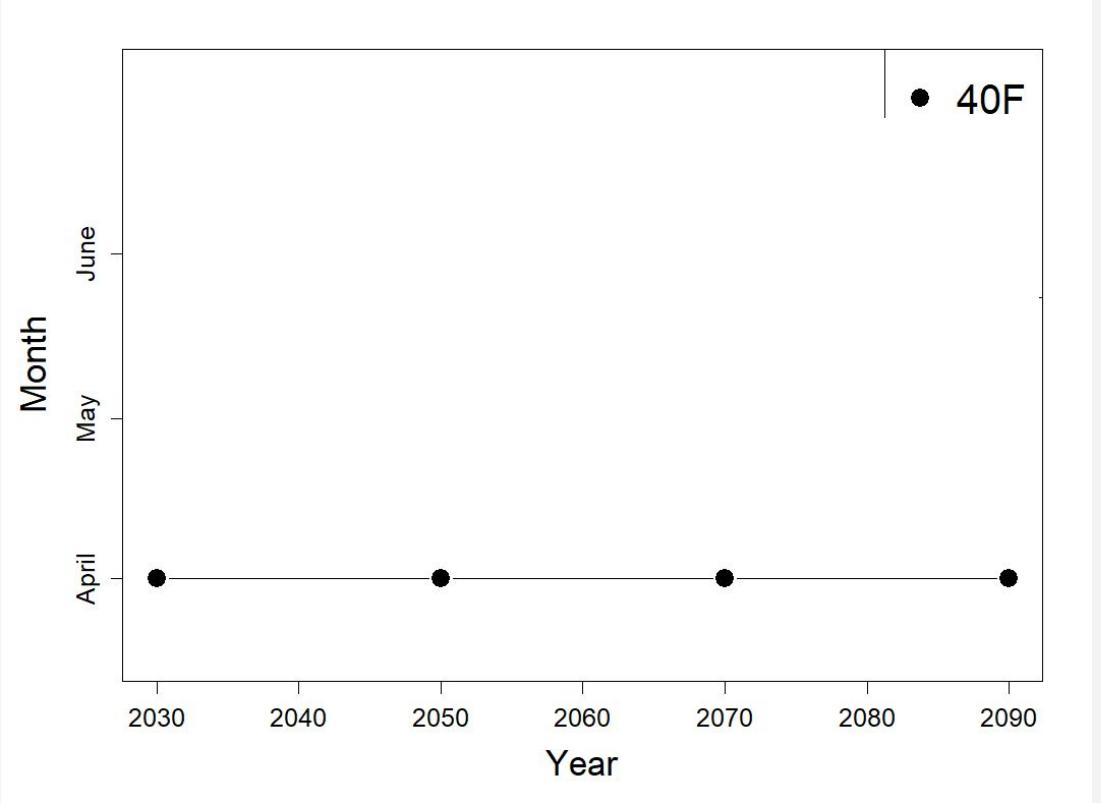
Climate Projections

Soil Temperature



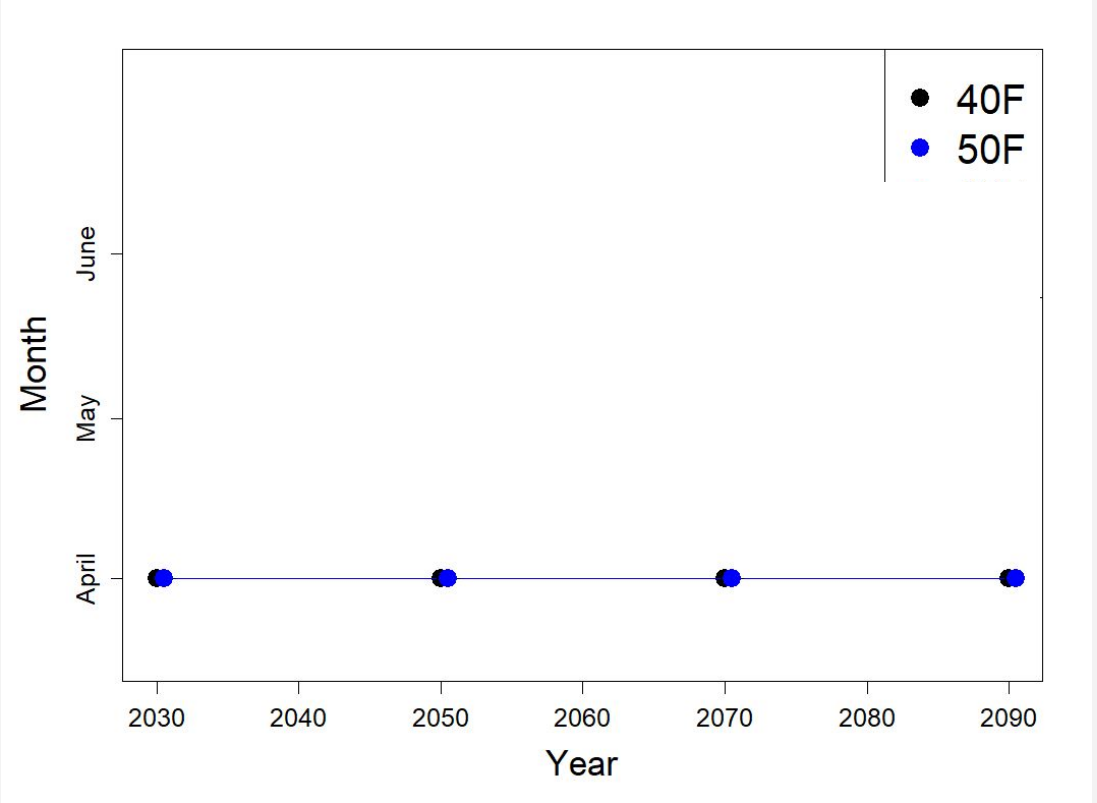
Climate Projections

Soil Temperature (4in depth)



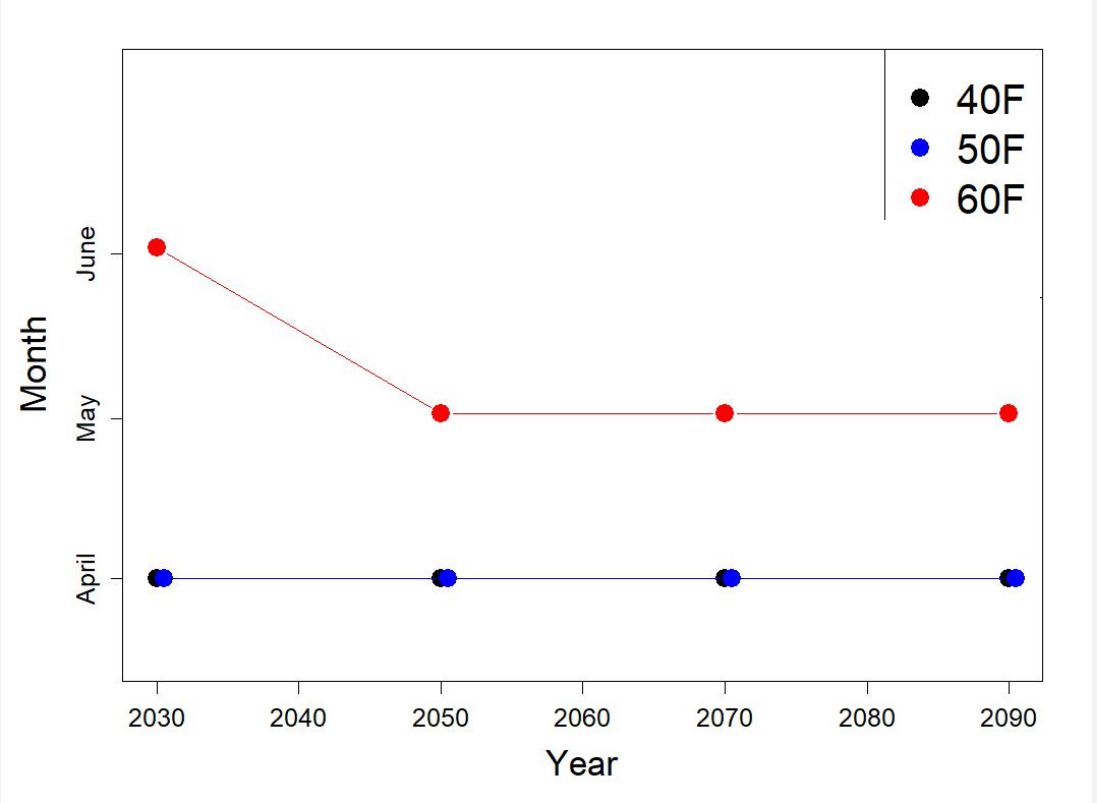
Climate Projections

Soil Temperature (4in depth)



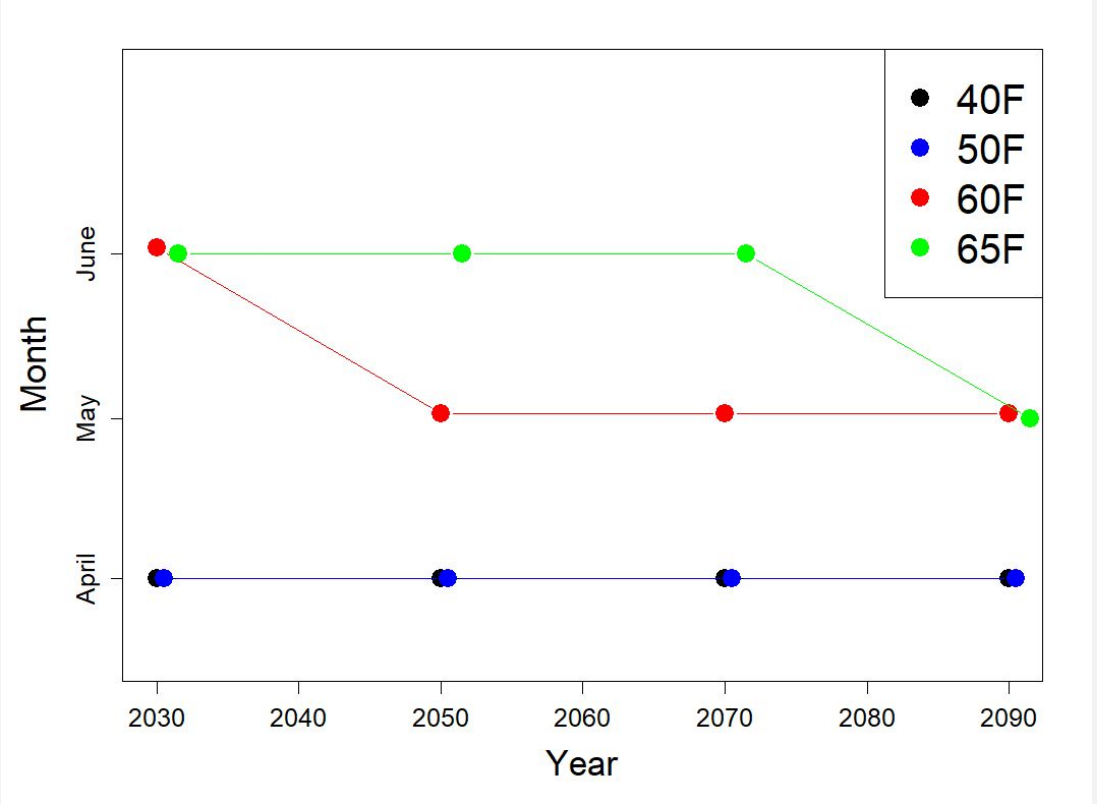
Climate Projections

Soil Temperature (4in depth)



Climate Projections

Soil Temperature (4in depth)



Climate Suitability

Growing Season - excess days

Crop	FFD 2030	FFD 2050	FFD 2070	FFD 2090
Alfalfa	135	139	143	146
Silage corn	65	69	73	76
Spring wheat	85	89	93	96
Barley	105	109	113	116
Oat	93	97	101	104
Safflower	60	64	68	71

Climate Suitability

Growing Season - excess days

Crop	FFD 2030	FFD 2050	FFD 2070	FFD 2090
Alfalfa	135	139	143	146
Silage corn	65	69	73	76
Spring wheat	85	89	93	96
Barley	105	109	113	116
Oat	93	97	101	104
Safflower	60	64	68	71

Crop	FFD 2030	FFD 2050	FFD 2070	FFD 2090
Forage sorghum	44	48	52	55
Forage sugarbeets	50	54	58	61
Sunflower	55	59	63	66
Sesame	-1	3	7	10
Dry edible beans	19	23	27	30
Grain sorghum	14	18	22	25
Lentils	88	92	96	99

Climate Suitability

Growing Season - excess days

Crop	FFD 2030	FFD 2050	FFD 2070	FFD 2090
Alfalfa	135	139	143	146
Silage corn	65	69	73	76
Spring wheat	85	89	93	96
Barley	105	109	113	116
Oat	93	97	101	104
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Sesame	-1	3	7	10
Dry edible beans	19	23	27	30
Grain sorghum	14	18	22	25
Lentils	88	92	96	99

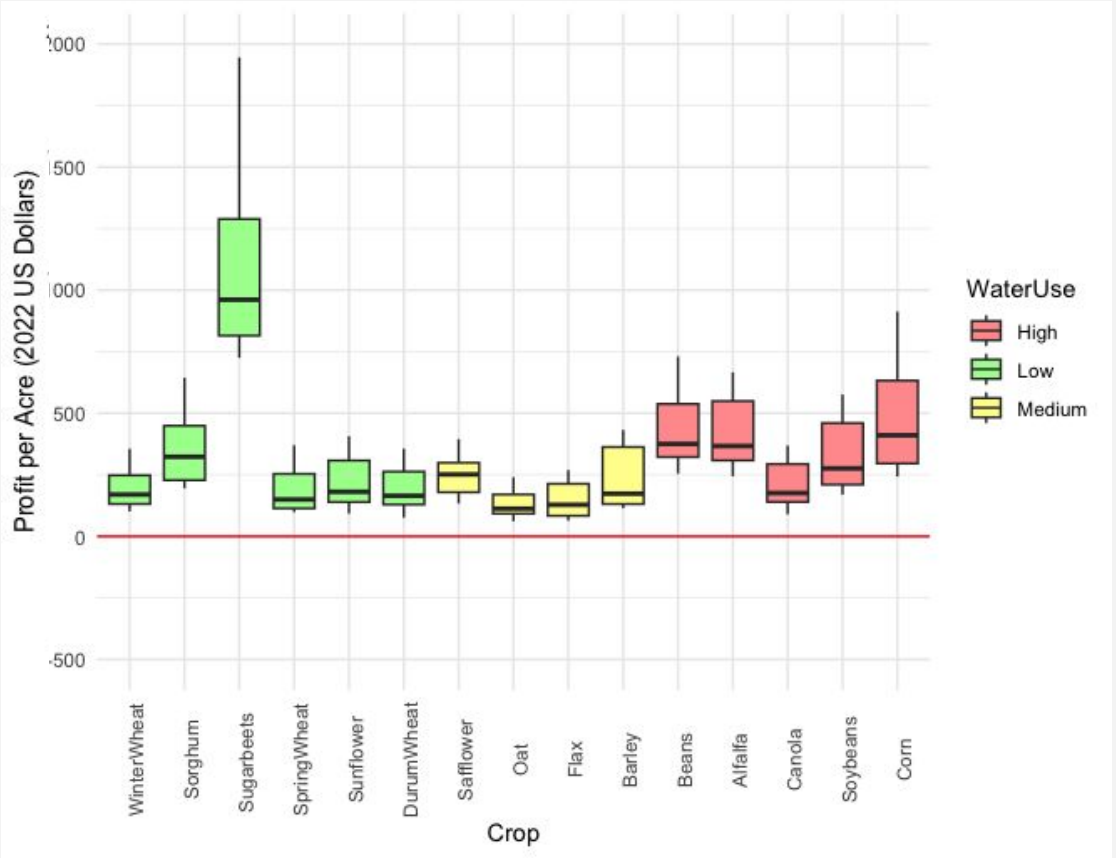
Economic Methods

- ➔ Historical data used to characterize price markets, adjusted for inflation into 2022 USD
- ➔ Prices tied to water requirements
- ➔ 2022 crop budgets used to estimate costs and paired with 2022 price-derived revenues to determine net profits

Economic Trends

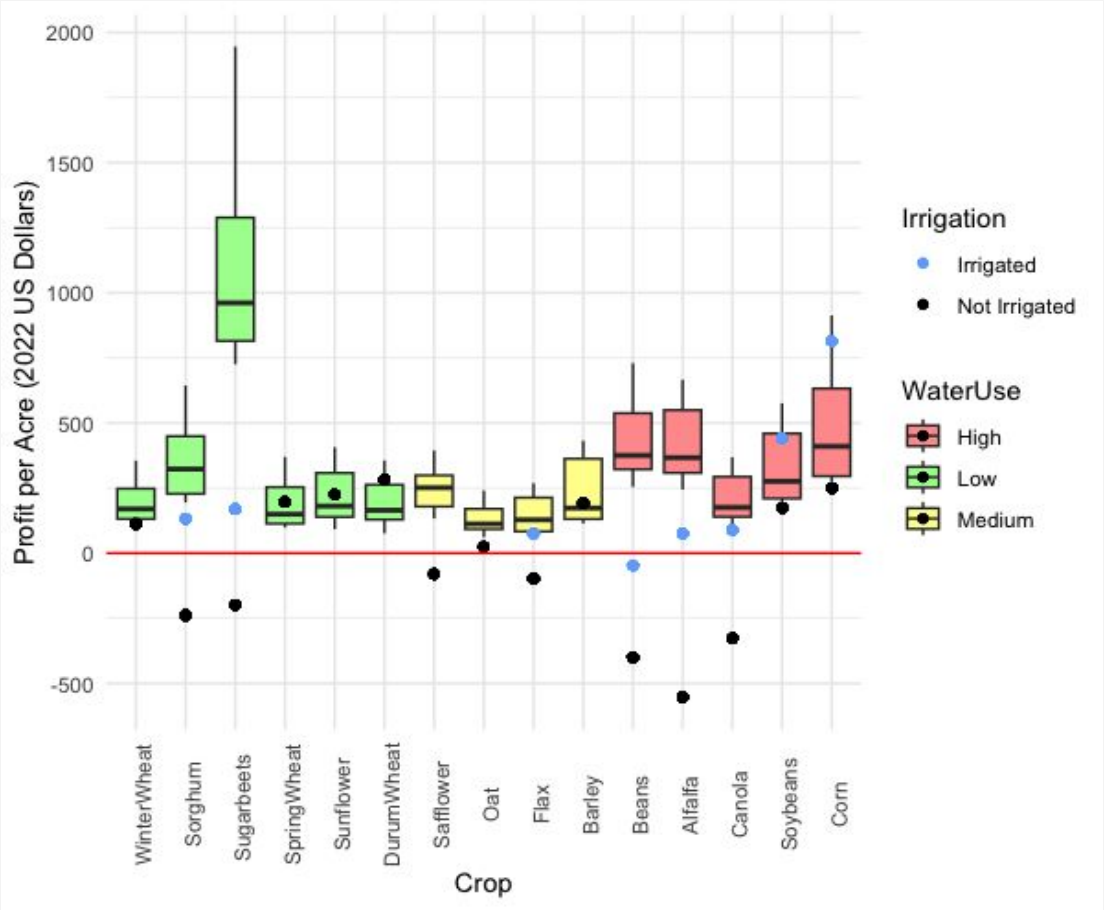
➔ Box and whisker plot of 30 year market value trends

Market Variability 1991-2021



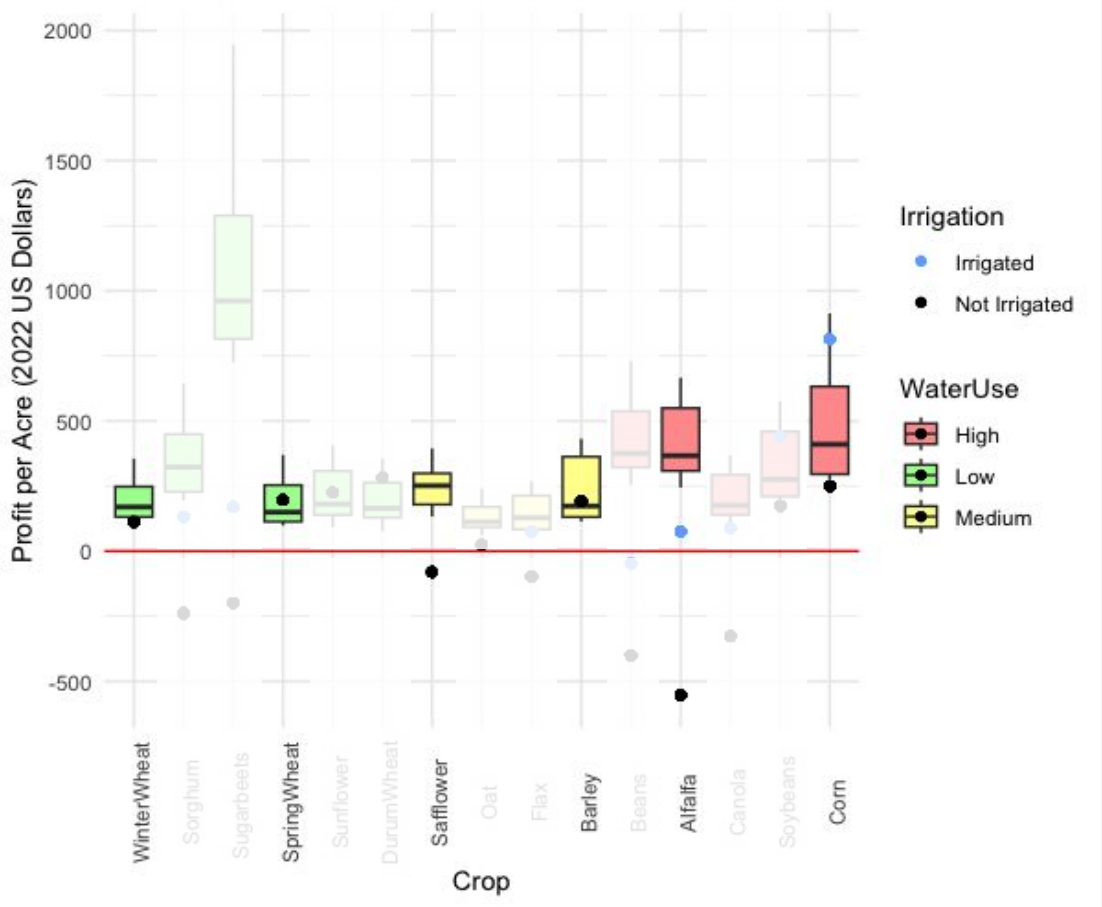
Economic Trends

- ➔ Box and whisker plot of 30 year market value trends
- ➔ Points are estimated 2022 profits per acre



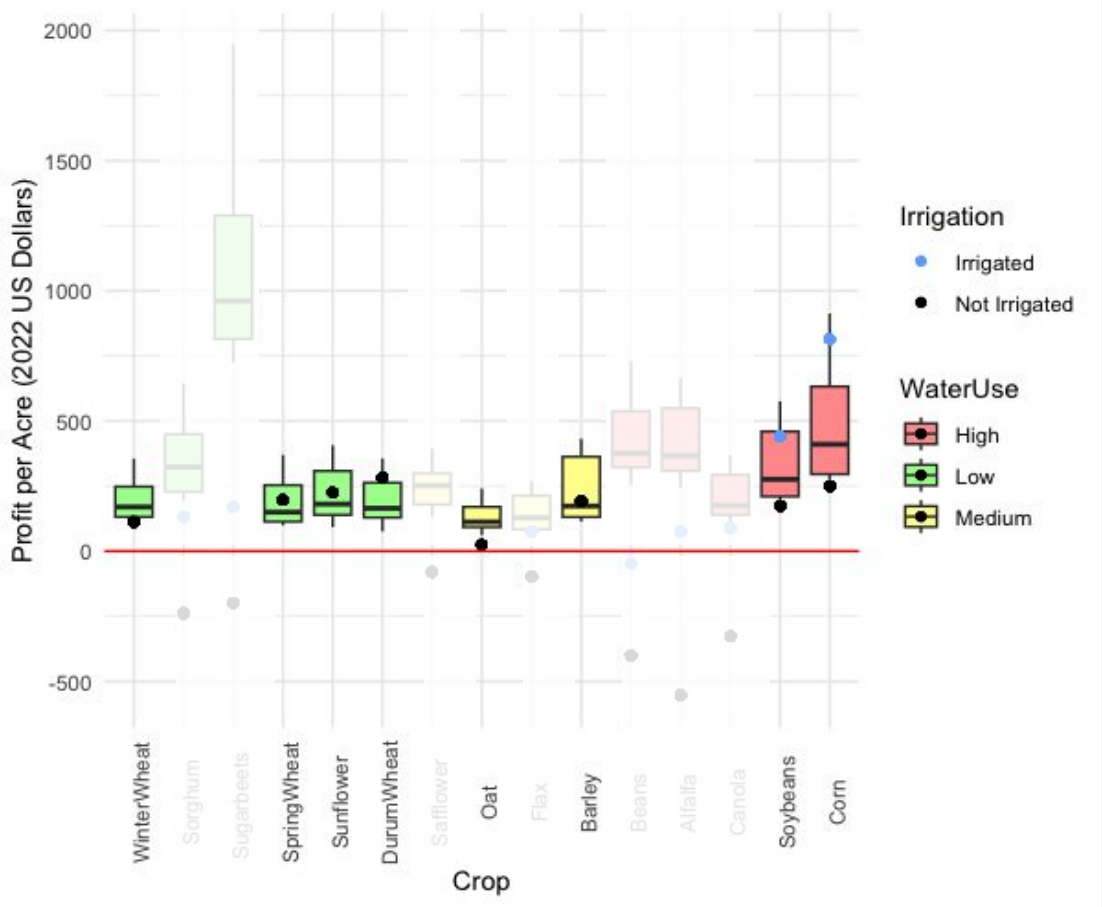
Economic Trends

- ➔ Highlighted are current most common crops by acreage
  - Hay/Alfalfa - 46%
  - Wheat - 12%
  - Corn - 6%
  - Barley - 5%
  - Safflower - 3%
  - Other - 25%



Dryland Crops

Extreme Drought	Winter Wheat
	Spring Wheat
	Sunflower
Moderate drought	Durum Wheat
	Oats
	Barley
No drought	Soybeans
	Corn



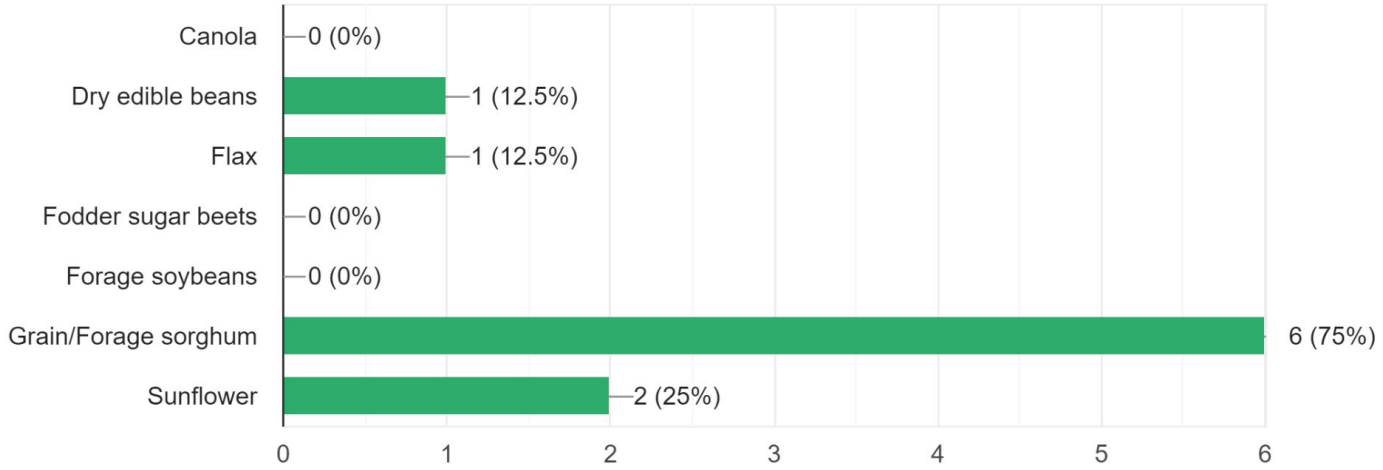
Producer Input

- Presented at Cache County Crop School
- Some alternatives already being grown
  - Sorghum
  - Sunflower
- Markets appear to be common challenge for trying alternatives

Producer Input

Do you have experience growing any of the crops we discussed? Please mark below.

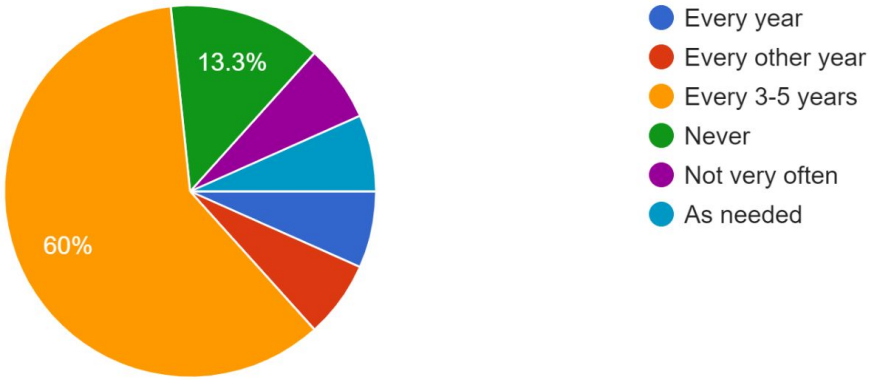
8 responses



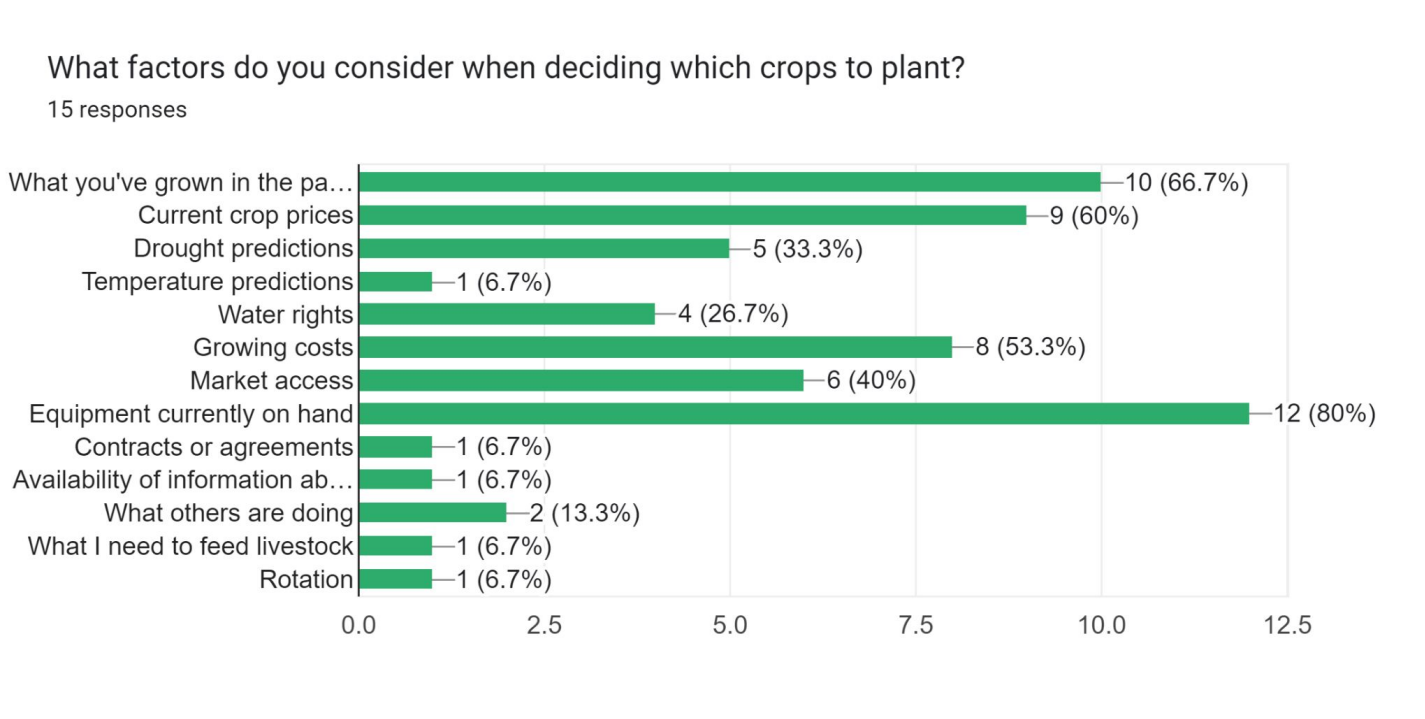
Producer Input

How often do you change which crops you are growing because of unexpected changes to external factors (e.g. water availability, markets)?

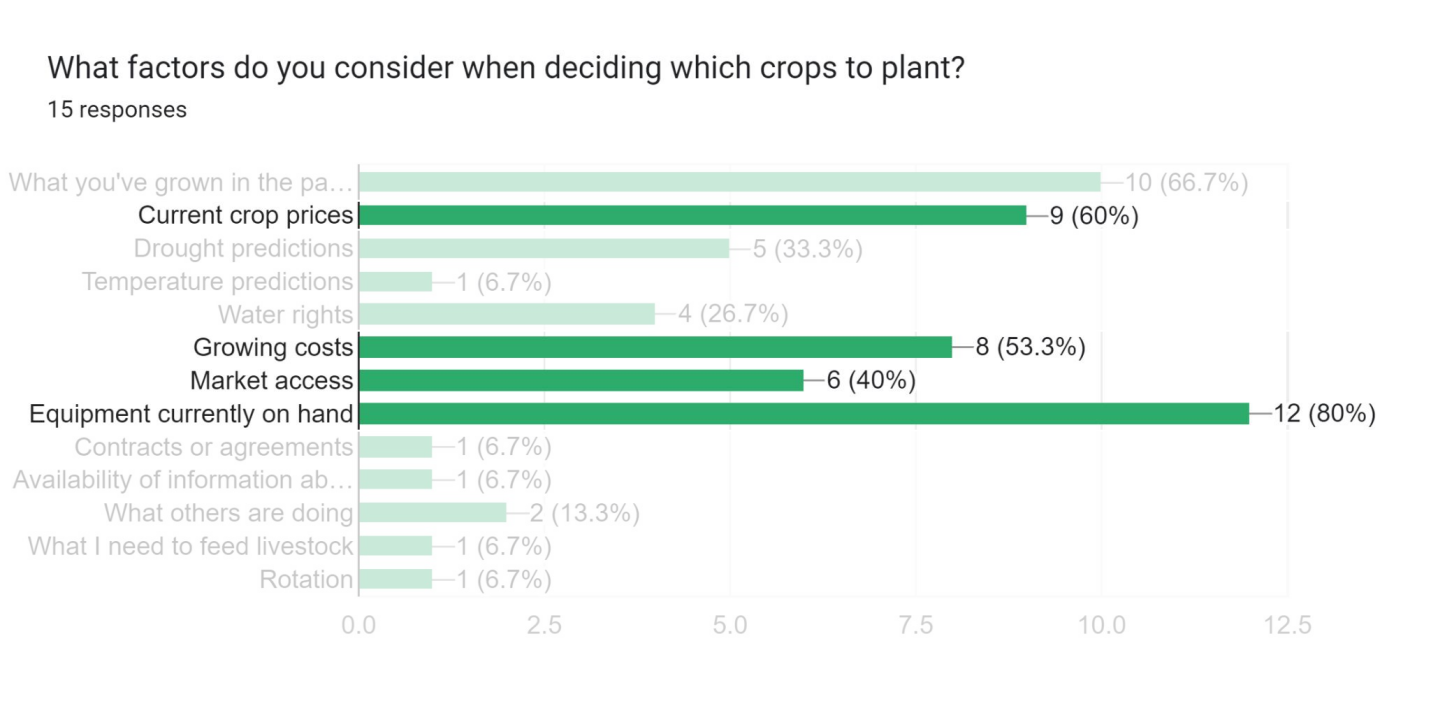
15 responses



Producer Input



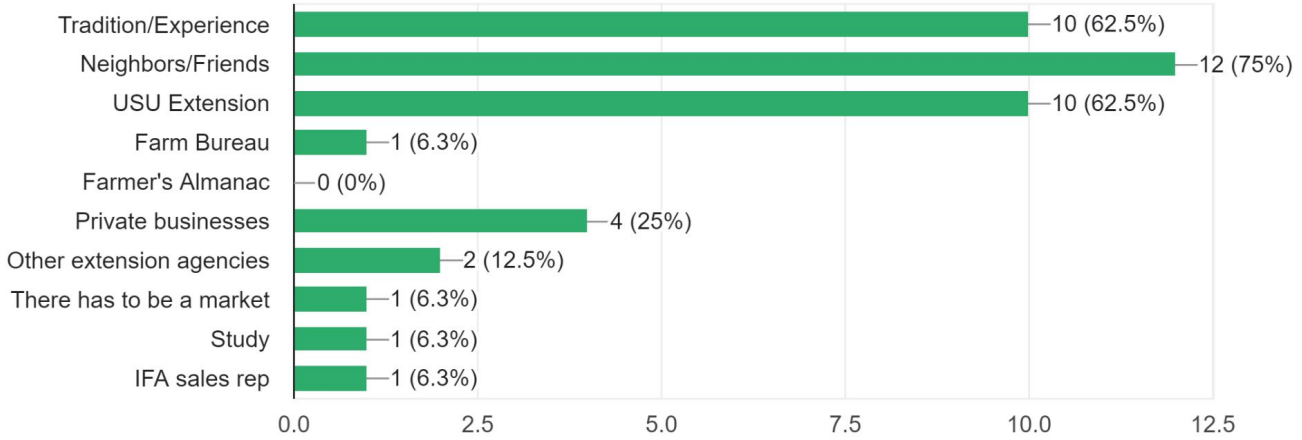
Producer Input



Producer Input

Where do you get your information for deciding which crops to plant? Please check the ones you use.

16 responses



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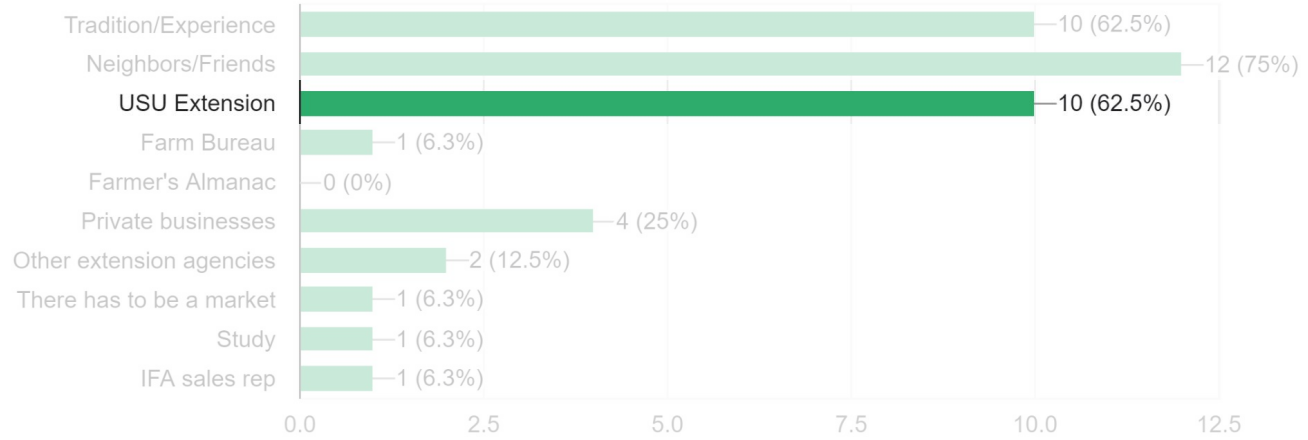


Final Products

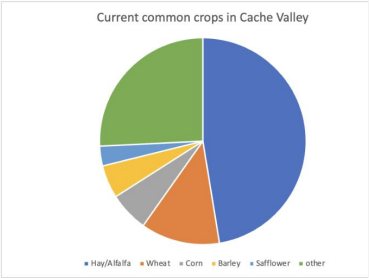
- ➔ Publish on USU Extension Website
  - ◆ Website to compare crops & economic trends

Website draft:

Page Title: **Alternative Crops for Cache Valley**

Section 1 Title/header: **Benefits of Alternative Crops**

Text: Cache Valley is currently dominated by a few commonly grown crops. However, there are also several alternative crops that are well suited to the climate of the region. Adding these crops into rotations with crops that are already commonly grown can add drought tolerance, lowering risk of losses because of drought. Some alternative crops may also be more profitable than some of the currently grown crops, though in some cases markets may be difficult to find. Learn more about potential alternative crops below.



Section 2 Title/header: **Explore Alternative Crops for Cache Valley**

Final Products

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  - ◆ Website to compare crops & economic trends
  - ◆ Crop fact sheets

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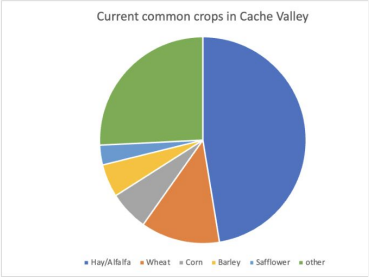

Section 2 Title/header: **Explore Alternative Crops for Cache Valley**

Fact sheets: Sunflower, Canola, Soybean, Sugar beet, Flax, Dry beans

Introduction

Sunflower (*Helianthus annuus*) is a large flowering crop in the Asteraceae family native to North America. Sunflower has been used by humans for thousands of years and was grown by Native Americans before European settlement of the Americas, but it didn't take off as a crop in the United States until the 1970s. After sunflower was introduced to Europe it became popular in Russia, where plant breeders developed the crop to make it more suitable for consumption as food because it was one of the only oily foods allowed by the Orthodox Church during Lent. After the crop was developed it was reintroduced to the US, where it became a popular crop.

Worldwide, Ukraine and Russia are the leading sunflower producers. According to the National Agricultural and Statistical Service, about 1.5 million acres of sunflower are planted every year in the US, with North and South Dakota leading production at the state level. Sunflower is a highly versatile crop and can be used as an oilseed, birdseed, confectionary and food use, as a cover crop or as an ornamental. Sunflower also has several other benefits, such as improving soils, and helping pollinators, other beneficial insects, and songbirds. If you are interested in growing sunflower and would like more detailed resources, there are several places to look. Both North Dakota State University (https://www.ag.ndsu.edu/publications/crops/sunflower-production-guide) and South Dakota State University (https://extension.sdstate.edu/sites/default/files/2022-03/P-00205-Book-v2.pdf) have extensive guides, and the University of Wyoming has a guide on specifically cut sunflowers (https://wyoextension.org/parkcounty/wp-content/uploads/2016/03/A-Wyoming-Growers-Reference-Guide-to-Cut-Sunflowers.pdf)

Introduction

Canola is an oilseed crop in the mustard family, Brassicaceae. Originally a European rapeseed, Canola was developed by Canadian plant breeders to create an oilseed that was low in erucic acid and more fit for consumption as food (hence the name--CANadian Oilseed Low in Acid). It is a very common oilseed crop, second only after Soybeans. The US is currently the fourth largest canola producer, after the EU, China, and Canada, however the US currently imports much of its canola oil, signaling the potential for a domestic canola market. North Dakota produces the majority of the canola in the US, producing 1.8 of the 2.2 million acres of canola grown in the US 2022 (NASS).

Canola can be grown very similarly to wheat-- it can be a spring or winter crop and uses much of the same equipment. Wheat can be replaced with canola in many crop rotations, such as a corn-canola-soybean rotation, but because canola can act as a disease bridge, planting it in the same field more than once every three years should be avoided. Additionally, some crops should be avoided in rotation with canola because of disease, including other brassicas (rapeseed, mustard), pea, dry bean, flax, sunflower, alfalfa, and safflower. Canola can be double cropped with soybeans, sunflowers, sorghum, cowpeas and pearl millet.

Uses

Many of Canola's uses are very similar to soybean. Most canola seed is used to produce vegetable oil, used for cooking and production of many processed foods. Canola can also be used to make biodiesel, diesel fuel made from plants (or sometimes animal fat) instead of petroleum. Both production of biodiesel and vegetable oil create a meal byproduct that can be used as animal feed, and occasionally whole seeds are ground to be used as animal feed. Canola can also be used as a cover crop, planted in the fall and killed in the spring by mowing,

Final Products

- ➔ Publish on USU Extension Website
  - ◆ Website to compare crops & economic trends
  - ◆ Crop fact sheets
- ➔ Publish on Utah Climate Center Website
  - ◆ Climate model report
- ➔ Give report to USU Extension
  - ◆ Climate model
  - ◆ Producer survey responses

Website draft:

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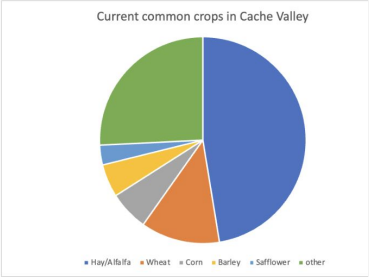

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Introduction

Sunflower (*Helianthus annuus*) is a large flowering crop in the Asteraceae family native to North America. Sunflower has been used by humans for thousands of years and was grown by Native Americans before European settlement of the Americas, but it didn't take off as a crop in the United States until the 1970s. After sunflower was introduced to Europe it became popular in Russia, where plant breeders developed the crop to make it more suitable for consumption as food because it was one of the only oily foods allowed by the Orthodox Church during Lent. After the crop was developed it was reintroduced to the US, where it became a popular crop.

Worldwide, Ukraine and Russia are the leading sunflower producers. According to the National Agricultural and Statistical Service, about 1.5 million acres of sunflower are planted every year in the US, with North and South Dakota leading production at the state level. Sunflower is a highly versatile crop and can be used as an oilseed, birdseed, confectionary and food use, as a cover crop or as an ornamental. Sunflower also has several other benefits, such as improving soils, and helping pollinators, other beneficial insects, and songbirds. If you are interested in growing sunflower and would like more detailed resources, there are several places to look. Both North Dakota State University (https://www.ag.ndsu.edu/publications/crops/sunflower-production-guide) and South Dakota State University (https://extension.sdstate.edu/sites/default/files/2022-03/P-00205-Book-v2.pdf) have extensive guides, and the University of Wyoming has a guide on specifically cut sunflowers (https://wyoextension.org/parkcounty/wp-content/uploads/2016/03/A-Wyoming-Growers-Reference-Guide-to-Cut-Sunflowers.pdf)

Introduction

Canola is an oilseed crop in the mustard family, Brassicaceae. Originally a European rapeseed, Canola was developed by Canadian plant breeders to create an oilseed that was low in erucic acid and more fit for consumption as food (hence the name--CANadian Oilseed Low in Acid). It is a very common oilseed crop, second only after Soybeans. The US is currently the fourth largest canola producer, after the EU, China, and Canada, however the US currently imports much of its canola oil, signaling the potential for a domestic canola market. North Dakota produces the majority of the canola in the US, producing 1.8 of the 2.2 million acres of canola grown in the US 2022 (NASS).

Canola can be grown very similarly to wheat-- it can be a spring or winter crop and uses much of the same equipment. Wheat can be replaced with canola in many crop rotations, such as a corn-canola-soybean rotation, but because canola can act as a disease bridge, planting it in the same field more than once every three years should be avoided. Additionally, some crops should be avoided in rotation with canola because of disease, including other brassicas (rapeseed, mustard), pea, dry bean, flax, sunflower, alfalfa, and safflower. Canola can be double cropped with soybeans, sunflowers, sorghum, cowpeas and pearl millet.

Uses

Many of Canola's uses are very similar to soybean. Most canola seed is used to produce vegetable oil, used for cooking and production of many processed foods. Canola can also be used to make biodiesel, diesel fuel made from plants (or sometimes animal fat) instead of petroleum. Both production of biodiesel and vegetable oil create a meal byproduct that can be used as animal feed, and occasionally whole seeds are ground to be used as animal feed. Canola can also be used as a cover crop, planted in the fall and killed in the spring by mowing,

All together now one last time!

We have com-bined our knowledge to harvest the data, help farmers go hog wild, and sow the seed to make it grain!

THANK YOU

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